EX PARTE OR LATE FILED

November 14, 1996

Chairman Reed Hundt
Federal Communications Commission
1919 M Street, NW
Washington, D.C 20554

Re: Permissible Ex Parte Presentation - MM Docket 87-268
In the Matter of: Advanced Television Systems and Their Impact Upon the Existing Television Broadcast Services

Dear Chairman Hundt:

On October 11, 1996, a team of broadcasters and experts concerned with advanced television visited DemoGraFX for a demonstration of their technology. We believe that the conclusions of this group have an important bearing on the issues in the Fifth Notice of Proposed Rulemaking in the captioned proceeding, especially in regard to the response to that Notice by CICATS, which includes the DemoGraFX system proposal as an alternative approach to DTV coding.

After viewing the DemoGraFX demonstration and discussing the system with the system designers, our conclusions are that the DemoGraFX system does not demonstrate any new or fundamental breakthroughs in compression coding, and that it is not a viable alternative to the ATSC A/53 standard for television broadcasting. The detailed technical report of this team is attached and is submitted as a permissible ex-parte presentation for inclusion in the public record in the Fifth NPRM proceeding.

Sincerely,

The Ad Hoc Panel

Carol Darling (ABSOC)
Ken Davies (CBC)
David Elliot (ABC)
Kent Ewing (Leitch)
Bernie Lechner (consultant)
Bruce Penney (Tektronix)
Glenn Reitmeier (Sarnoff)
Rupert Stow (consultant/CBS)
Peter Symes (Tektronix)
Stan Baron (NBC)

Attach.

cc: Gary Demos
Saul Shapiro - FCC
William Caton, Acting Secretary - FCC (2 copies)

Please send responses to:

David Elliot
Vice President, Engineering Services
ABC, Inc.
47 West 66th Street
New York, NY 10023

REPORT OF AD-HOC PANEL OF BROADCASTERS AND TELEVISION EXPERTS CONCERNING DEMONSTRATION OF HDTV CODING BY DEMOGRAFX INC, SANTA MONICA CA

11 October, 1996

Prepared by: Kenneth P. Davies
November 11, 1996

EXECUTIVE SUMMARY

Following a review of the DemoGraFX system of layered coding, as proposed in the CICATS filing to the FCC in response to DTV NPRM 5, an ad hoc group of broadcasters and television industry experts evaluated the system in light of a demonstration and discussion session with DemoGraFX personnel. The panel determined that the DemoGraFX system does not demonstrate any new fundamental breakthroughs in compression coding, but it does demonstrate an innovative attempt to recast the tradeoffs that are inherent in the design of a compressed video system. Because of its reliance on "soft borders" and excessive channel change time to enable the data stream to fit within the limited data rate available in the 6 MHz terrestrial channel, the DemoGraphX system is not a viable alternative for television broadcasting. However, its system attributes are worth further study and may be suitable for other delivery media and applications.

INTRODUCTION

The ATSC A/53 standard for ATV broadcasting, currently under consideration by the FCC for adoption as the US standard for digital broadcasting services (DTV), includes the video format of 1920 (H) X 1080 (V) pixels in interlaced form at a 60 Hz field rate as one of the highest resolution members of a family of formats. The other high resolution formats include 1920 (H) X 1280 (V) pixels at 24 and 30 fps progressive and 1280 (H) X 720 (V) pixels at 60, 30 and 24 fps progressive. These formats are then coded in accordance with the MPEG-2 standard at the Main Profile, High Level, forming an HDTV signal layer in the broadcast data stream. The video formats and coding arrangement have been subjected to considerable testing in the laboratory, both subjectively and objectively and have been found to offer a very high quality of recovered video, across a wide range of challenging pictures. They have thus been recommended for inclusion in the standard (See Report of FCC Advisory Committee, Nov. 1995).

Never-the-less, some believe that other, higher resolution video formats may be desirable for some purposes and that advances in technology may render them feasible either

currently, or early in the life of the standard under consideration. In particular, proposals have been advanced that include some or all of the following elements:

* A move from the 16:9 aspect ratio proposed in the standard to a 2:1 aspect ratio with a small consequential increase in the pixel matrix from 1920 (H) X 1080 (V) (2.07 million pixels) to 2048 (H) X 1024 (V) (2.09 million pixels).

* An increase in frame rate to a newly-proposed progressively scanned frame rate of 72 Hz;

(The net effect of the above two proposed changes would be an increase in the load on the encoder from 62 million to 151 million pixels per second).

* An extension of the analysis and transmission coding colorimetry to include a color gamut more closely approximating that of good motion picture film.

PARTICIPATION

Taking advantage of the gathering of engineering community at the SMPTE World Media Expo in Los Angeles in October, a number of experts accepted an invitation to view the HDTV Coding proposed by DemoGraFX as part of the CICATS filing to the FCC in response to NPRM 5 on DTV. The members of the ad-hoc group viewing the demonstrations and whose personal professional opinions form the basis of this report, consisted of the following:

Carol Darling (ABSOC)
Ken Davies (CBC)
David Elliot (ABC)
Kent Ewing (Leitch)
Bernie Lechner (consultant)
Bruce Penney (Tektronix)
Glenn Reitmeier (Sarnoff)
Rupert Stow (consultant/CBS)
Peter Symes (Tektronix)

Other experts who have participated in earlier presentations of the same, or similar, demonstration, and who concur in this report, include:

Stan Baron (NBC)
Bob Rast (General Instrument)

FORMAT OF DEMONSTRATION

The demonstration is based on simulations played from a Viewgraphics system to a modified high-resolution display produced by Barco and projected onto an 8 foot screen. The projected image was modified in its colorimetry by the insertion of filters to increase red, green and blue saturation in each of the three optical paths. Display brightness was subjectively acceptable for critical viewing in the darkened room. Display resolution is considered acceptable at the display rates used and some critical areas of the picture sequences were displayed in magnified form, on a before/after basis on the screen, effectively removing the display system from the results.

Source materials for the demonstration consisted of short (a few seconds) repeated sequences, derived by scanning at very high resolution from 35 mm film exposed at high frame rate (72 fps) and electronically down-converted to the 2048 X 1024 images forming the input to the demonstration.

PROCESSED SEQUENCES

All sequences demonstrated were derived from film, as noted, and thus included significant film grain. No live camera material was included. Images were thus not comparable with those used previously in more controlled tests of HDTV. The high resolution sequences concentrated on the temporal elements of coding, seeking the extreme cases and could not adequately cover the range including "good HDTV" in electronic form including low-noise, sharp background combined with high-resolution foreground motion and saturated, contrasty colors, common to television production in electronic form. These factors, if present, stress the compression methodology and provide a better comparison of the effects of the material on compression approaches employed by different systems. Comparisons with the results of other approaches are thus problematical.

DETAILS OF DEMONSTRATED CODING

1. The simulations of the DemoGraFX system used MPEG-2 coding in two layers with a GOP length of 72 frames (i.e., 1 second between I frames). The GOP sequence used is IBPBPBP...BP.

Comment. The ATSC A/53 system generally operates with GOP lengths of 15 frames. Increasing the GOP length gains compression efficiency, since I frames have by far the most bits, but it also limits channel change time, since MPEG decoding must begin on an I frame. A one second channel change time (including all contributions to it) has been shown to be unacceptable for broadcasting. Extrapolation of this coding method to include a GOP length appropriate for broadcasting applications would result in a required bit rate significantly higher than 18 Mb/s, which is the rate both demonstrated and available in the ATSC A/53 system.

2. The approach to compression demonstrated employs a base layer at a resolution close to the proposed 480-line progressively-scanned TV system plus an enhancement layer carrying the high resolution (HDTV) information. This approach has been researched by a number of laboratories and is documented within the MPEG-2 standard as the Spatially Scalable Profile. The implementation in the demonstration includes an additional enhancement component in the upper layer, beyond the MPEG-2 standard approach.

One demonstration showed 18 Mb/s compression with a 10 Mb/s base layer and an 8 Mb/s enhancement layer. Questioning revealed that the enhancement layer is limited to a spatial window within the full frame that comprises roughly 56% of the total picture area (i.e., the high-resolution centre of the picture is surrounded by base-layer resolution "side panels" and "top/bottom panels", each approximately 12.5 percent of the linear dimension). DemoGraFX adopted this approach in their model, reducing the required data rate, by assuming that the focus of interest would always be the center of the frame, and that the "edges" of the picture could be transmitted at the lowest resolution.

Comment. The picture material shown to the group was so generally soft that a "resolution seam" was not apparent, but the group voiced a clear consensus that the "soft borders" approach using a windowed high-resolution region was not an acceptable one. Further demonstrations to one member of the ad-hoc group included two additional sequences of interest. In the "walker/white fence" scene, the resolution seam was readily apparent, even though there was very little texture crossing the seam in the scene. In particular, the seam was visible on the white fence, due to luminance differences in the base layer vs. the base plus enhancement picture. Discussion about layered coding of the entire picture led to the conclusion that the 18 Mbps simulations were really showing pictures that would require at least 22 Mb/s to transmit, if the enhancement layer was coded in its entirety. This conclusion is supportable also from the research results reported concerning two-layer coding of picture sequences.

The concept of "soft borders" included in the demonstration may also be a cause of concern to users of HDTV in the computer industry, where full screen resolution is of critical importance for the display of information. Further reservations may also arise in the position of the ASC, in which the cinematographers demand that their artistic intent in a motion picture be respected and transmitted unmodified.

3. At the 1995 SMPTE Television Conference (San Francisco, February, 1995), DemoGraFX demonstrated down-conversions from 72 fps to 60, 36 and 24 fps and these demonstration sequences were re-visited by some members of the ad-hoc group. Although the conversions to 36 and 24 fps exhibited good performance, the simulations exhibited substantial judder artifacts at 60 Hz.

Comment. Since the latter is precisely the situation that would result for a large NTSC audience in the early days of HDTV production, it would effectively prevent 72 Hz based HDTV from ever starting. There was no convincing evidence that 72 Hz had adequate interoperability with NTSC to be a viable approach for simulcast HDTV.

CONCLUSIONS

1. The demonstrations are technically quite interesting and exhibit considerable ingenuity in crafting the sequences and implementing the demonstrations. The sequences demonstrated are believed to be fully in accordance with the stated format and coding algorithm, and presented in an appropriate viewing environment. It is clear that progressive coding of the image, as demonstrated here and in many other demonstrations, can improve coding efficiency and picture quality. However, the availability of both interlace and progressive formats in the ATSC A/53 standard remains advantageous for broadcasting.

2. The concept of "soft borders" in the enhancement layer, needed to keep the bit rate within manageable bounds, is incompatible with the needs of the broadcasting environment, whether for high-quality entertainment or sports events.

3. Interoperability of a frame rate of 72 fps with conventional TV having a frame rate of 29.97 or 30 fps remains a major problem because of the motion artifacts which would result from the conversion processes. There is no evidence that a 72 Hz DTV system would produce acceptable quality NTSC simulcasts. Therefore, such an approach does not provide for a practical transition from NTSC to DTV service.

4. Studies of colorimetry indicate some advantage for an enhanced color gamut for video purposes, in view of new display devices and interoperability with other media. CRT technology is however the dominant one today (including new flat-panel plasma displays) and backward compatibility with current displays (of which billions exist in the world) must be strongly considered in any possible change. It is concluded within the ITU-R Study Group 11 (see Rec. BT.1200) and within SMPTE and EBU studies that a compatible enhancement can be achieved in the future. This provision in included in the ATSC A/53 standard. The color performance of the demonstration supports this approach, allowing migration of the display colorimetry on an individual, compatible basis.

5. The use of very long GOP's in the coding process, while raising coding efficiency, does not provide the "channel hopping" capability demanded by the broadcasting audience. Subjective assessments and market studies indicate an upper bound of about 600 msec for the TOTAL relocking time following a channel switch in a receiver. GOP lengths and sequences are also critical to the effective use of "partial decoding" of the HDTV stream in the decoder to produce an SDTV image from the HDTV bit stream, one of the receiver cost reduction approaches that potentially could be implemented by the consumer electronics industry.

6. Conclusive evaluations of the layered proposal for video coding would require time and resources well beyond those available to DemoGraFX acting alone, to stage, capture, process and evaluate the results subjectively and objectively and with adequate levels of control and repeatability. The possible sources of such resources in the current situation are not clear; further, there is no justification for giving the DemoGraFX system any preferential treatment

compared to other potential approaches. A fair, open process to solicit, test and evaluate this and other systems would clearly delay the deployment of DTV by at least several years.

7. The available record includes an adequate examination of the frame rate and progressive/interlace issues. The subject demonstration adds no new information, only confirming the difficulty in interoperability across 60 and 72 fps systems.

8. The range and type of material demonstrated is insufficient to obtain a numerical or subjective comparison with other coding proposals or previous testing.

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